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WESRAC
Western Research Application Center

FINAL REPORT
Contract Period Ending February 1, 1968
Contract NSR 05-018-071

Graduate School of Business Administration
University of Southern California
Los Angeles, California 90007

SUMMARY OF HIGHLIGHTS

1. WESRAC completes 9½ months of actual operation with tape. (p.7)
2. The NASA Program Review of WESRAC activities was effective and useful.
It indicated that WESRAC has established a strong foundation. (p.33)
3. Yardsticks for success of a Regional Technology Dissemination Center (RDC) are difficult to establish. Some considerations are:
 - a. number of clients
 - b. dollar value of the service to clients
 - c. self-sufficiency at a minimum \$250,000 gross income level
 - d. user opinion on a subjective basis
 - e. testimonials
 - f. renewals
 - g. quantity of material distributed
 - h. number of identifiable technology transfers.

A broader yardstick must be an appraisal of the value to the economy from educating industry to avoid duplication of effort by effective use of large information banks. (pp.35-37)
4. Companies do not line up to receive technology from the NASA file. (p.35)
5. Marketing efforts have been large. (pp.18-22)
 - a. over 500 organizations received personal individual calls
 - b. over 3,000 direct mail contacts were made
 - c. newspaper advertising was used
 - d. numerous articles appeared as news or information
 - e. radio and two TV programs were used. (One TV program was a syndicated half-hour which appeared throughout the West and in other parts of the United States.)
6. Newspaper advertising is successful in the West and produced 125 leads at modest cost. (pp.20-21)
7. Education of companies to utilize technology and what someone else has already done as part of their regular way of doing business takes a major share of NASA RDC Marketing dollars. (p.37)

8. About 6% of prospects receiving personal calls become clients. (p. 26)
9. Clients at February 1 numbered 29. (p.26)
10. NASA contractors are logical candidates for RDC service in connection with commercial phases of their business. (p.18)
11. The WESRAC product is service: efficient access to the NASA computerized bank via retrospective and current awareness searches. Personal service by specialist is emphasized. (p.15)
12. Fees for WESRAC service ranged from \$120 to \$190 for retrospective searches and \$350 to \$400 for annual monthly progress searches (current awareness type). Unit price depends on size of annual client commitment from \$1,000 to \$5,000. (p.16)
13. Client use of WESRAC services even after paying for it needs great attention. A client manual for use of WESRAC services is being developed. Monthly status-of-work reports to clients remind them of service availability. (p.29)
14. Original organization design with three departments (Marketing, Engineering, Information) proves satisfactory. (p.10)
15. Staff reaches 30. Two-thirds continue to be part-time students or faculty. (pp.10-11)
16. University relationship is valuable to both the University and the NASA Regional Dissemination Center. (p.14)
17. Engineering and scientific graduate students prove to be best source for specialists to support WESRAC service. (p.28)

18. Part-time personnel as a major source of staff provides variety and helps education but requires continuous training and WESRAC is not their major commitment. (p.11)
19. Short one-year financial support contracts to start a permanent "business", such as an RDC is intended to be, create problems in securing and holding competent personnel. (pp.10-11)
20. The WESRAC computer search program is normally conducted on the IBM 1401. However, this program has been tested and works also on the IBM 360-40. (p.31)
21. Computer search time has been reduced to one-fourth the time required at beginning of year. (p.31)
22. ACORDD, an organization of all NASA RDC centers in the United States for mutual support, was joined by WESRAC. (p.34)

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INTRODUCTION

This report assembles the pertinent results from the first year of operation by the Western Research Application Center, a Regional Dissemination Center for NASA technology, which was organized at the University of Southern California as part of the Graduate School of Business Administration and under the administrative control of the Business School's Research Institute for Business and Economics. It also reports ideas, problems, and suggestions which have been generated as a result of the experience gained during this period.

It should be noted that effective service could not actually be offered to industry until April 15, 1967. It was not until this date that the NASA file and computer index were available for use. While prior months were used for planning, assembling equipment, securing space, and for limited hiring, uncertain start-up dates precluded the sale of services on a "when available" basis. Further, staff could not be employed extensively until initial financing had been assured. This was achieved on February 15, when the contract for NASA support was signed.

This annual report, in addition to background, development, and operational information, will also provide some idea of goals, problems, and planning.

DEVELOPMENT OF WESRAC

WESRAC, the acronym for Western Research Application Center, was established with funds from the National Aeronautics and Space Administration (NASA) at the University as part of the Graduate School of Business Administration through the efforts of the Dean of the School, Robert R. Dockson, and his Director of Research Institute for Business and Economics, Joseph W. Ehrenreich. Its establishment followed a preliminary feasibility study completed August 15, 1966. This study outlined the market in the West for technology, such as that accumulated in the NASA computerized file, and measured the degree of acceptance efficient access to this technology file would receive from industry in this area. This survey reflected a strong favorable reaction from Seattle to San Diego. A representative sample of industry not only felt that having such a technology dissemination center was a good idea on a general basis, but most respondents stated that their own companies would buy the service.

In addition to these results, an analysis of the type and number of businesses in the West, compared to other areas in the United States where similar centers had been established, gave strong indications that NASA material was needed and that a center which required sufficient financial support from industry to cover expenses of operation would be successful.

Preliminary development of WESRAC was undertaken with the remnants of the staff previously utilized to make the feasibility study. They were carried over and supported during the gap in time between the end of the feasibility study contract and the beginning of the WESRAC operational contract. One man was added, a Marketing Manager, and during the several months prior to our beginning operational date (April 15th) and our financially secure

date (February 15th), his main job was:

1. Specific identification of potential clients
2. Development of call and mailing lists
3. Development of a marketing plan
4. The searching for qualified marketing personnel.

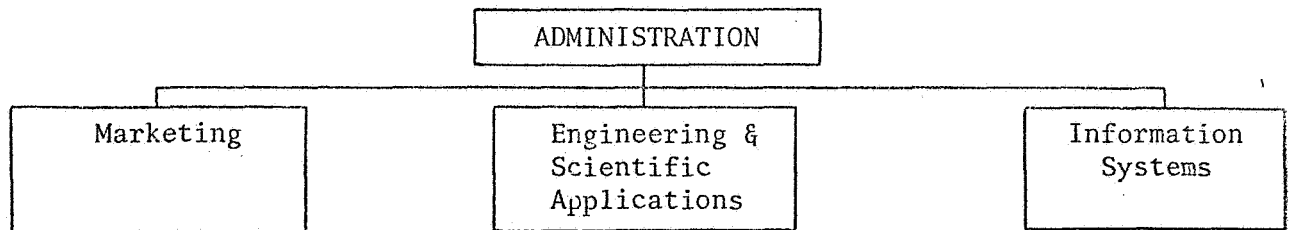
The search for other department heads also was a major problem for the Director during this period.

At the same time, space was a factor in the consideration of both present and future WESRAC operations. The space initially assigned by the University to the WESRAC project as headquarters for the feasibility study was inadequate and a physically awkward distance from campus facilities. Early in the year, however, two older buildings were assigned which are virtually on the campus and well located. While they are in fact residence type buildings and do not lend themselves to efficient operating arrangements easily, they have been modified substantially and receive good continuous care by the University. The move to these quarters, which have about 4,400 usable square feet, was made March 31. The space has been adequate with Administration, Marketing, and Engineering occupying Building No. I, and the Information Systems group, library and production activities occupying Building No. II.

Future plans on space look toward the construction of a new business office type building on University property which would include adequate space for WESRAC operation.

ORGANIZATION

The original basic design of WESRAC included three departments and an administrative group:



There has been no reason to change this simple design, which envisioned Marketing as the source of income and business, Engineering as the service arm to clients, and Information as the in-house service group for both Engineering and Marketing with the NASA tapes and other information material being in the custody of that department. However, every organization is built around individual capabilities. Responsibilities assigned to each department are arranged to utilize best the skills of each department head and staff as personnel changes have taken place. Responsibilities of individual departments are described in subsequent sections of this report. The organization chart (Appendix I) shows WESRAC organization as of the end of the year.

Personnel.

There are now ten full-time and twenty part-time individuals on the payroll of WESRAC. During the year, the quality of personnel has been a major concern, particularly at department head levels. Highly qualified individuals with business experience have headed up each of the three departments and the operation of WESRAC has been a full-time activity of business oriented individuals. Continued employment and success of these people depended upon the success of WESRAC. However, towards the end of the contract year, unusual financial and career opportunities coupled with the problems of annual contract

renewal and certain administrative policies inherent with University association, resulted in the loss of two principal department heads.

Inherent in WESRAC operations is the temporary nature of two-thirds of its personnel. The policy of using part-time employees from the student body and faculty of the University has both good and bad points. The disadvantages are:

1. Turnover and search for replacements
2. Need for continuous training
3. Work with new personalities continuously
4. Irregular hours
5. Lack of total identification with the WESRAC program.

On the plus side are the following advantages:

1. A reservoir of skills available which can be employed as needed
2. Less expensive rates
3. The contribution employment of students and faculty makes to the financing of education
4. The education provided to the student through working at WESRAC.

In the Engineering group, temporary use of personnel is particularly important because of the need for a variety of specialists whom we could not afford to employ full-time for the amount of use required.

Salaries for the WESRAC family have been adequate but modest by industry standards because of the need for compatibility with University scales and of course, budget limitations. It has not been feasible, for example, to buy the talent desired in competition with the great industrial demand for management-engineering types. Except for the appeal of two important factors, this would restrict employment, therefore, to young, relatively inexperienced types who could use WESRAC as a stepping stone or to quite older individuals who have been passed over too many times in their current occupation. These factors are, first, the idea of implementation of Technology Utilization as implied in the WESRAC charter and, second, association with a progressive

University such as the University of Southern California and its dynamic Graduate School of Business Administration. Unfortunately, the reservoir for talent that feels it can afford such association and can gamble on one-year contracts to financial independence in three to five years is small.

Projections for organization staffing needed at our planned financially independent level of \$300,000 gross income (based on today's fees and costs), indicate that some expansion will be necessary at that time. This would take place primarily in the Engineering and Scientific Applications group where additional skills and time will be required and in the Information Systems group where additional clerical help will be needed to process the additional publication of reports. Marketing would require little expansion because it currently operates at full strength. Additional marketing duties will include coverage of broader areas and the monitoring of relations with Small Business and State Act programs. Perhaps total numbers of WESRAC personnel will be increased to 35 with a higher percentage of full-time employees.

Advisory and Coordinating Committees.

As of year end, advisory committees have been of little help as a source of advice and support for WESRAC, although considerable advice from individuals has been sought and utilized. Two committees were envisioned early in the year, an Industrial Advisory Committee and an Academic Coordinating Committee. This latter group has been appointed and is composed of key University people such as the Dean of the School of Engineering, the Head of Library Science, and the Head of the Computer Facility, who are concerned with matters of interest to WESRAC.

It was originally thought that the Industrial Advisory Committee repre-

sented two potential advantages to WESRAC: first, advice on operations and business problems, and second, enhanced acceptance through the use of prominent names. It was concluded after an appraisal of results at other centers and of the utility achieved by similar committees locally that these two objectives could not be realized in one committee. Prominent names find their time spoken for to such a degree that an attempt to secure actual support for the project might be more frustrating than useful.

ACADEMIC RELATIONSHIPS

The Western Research Application Center - University of Southern California relationship has been mutually desirable. From the point of view of WESRAC, advantages have been:

1. Ready availability of part-time clerical help at reasonable prices from the graduate and undergraduate schools.
2. Technical specialist help with Engineering and Scientific skills, expandable in number and variety of support on an hourly basis from an excellent inventory of graduate students.
3. Faculty help for unusual specialist needs.
4. Several on-campus library sources of information for assistance in servicing clients.
5. Computer availability.
6. Improved acceptance of WESRAC in dealing with business through association with the Graduate School of Business and the University.

From the University point of view, a successful WESRAC provides the following advantages:

1. A favorable, direct working contact with hundreds of businesses in the West.
2. Increased opportunities for students to earn income on campus and thus further educational goals.
3. Direct exposure to actual business problems for students without business experience.
4. Maintenance of business type relationships as distinguished from purely academic application, for experienced graduate students and faculty.
5. Increased fund of information available on campus for research projects through maintenance of the large NASA bank.
6. Increased educational opportunities for students by providing exposure to a computer based information retrieval system.
7. Demonstration and implementation of the University's desire to be of service to the community.

THE WESRAC PRODUCT AND THE CLIENT

WESRAC's principal product is service--efficient access to the complete NASA file of unclassified reports plus supporting research into other files and libraries when required. Three vehicles are used for implementation of this objective:

1. Retrosearch - A complete search on a given subject or area of interest of the total NASA computerized file on hand.
2. Progress Search - An annual twelve-report search of the new material added each month to discover new references on a given subject or area of interest.
3. Seminars and Workshops - A general meeting in which experts present their papers on selected subjects.

The WESRAC product includes personal consultation with the client by a representative of WESRAC's Engineering and Scientific Applications group to establish a narrow definition of the client's area of interest or problem. The WESRAC representative is selected because of his knowledge about the client problem and is referred to as a specialist. His consultation with the client frequently results in some change in the client's understanding of his own problem and always results in narrowing the focus of our search.

Additional factors which the WESRAC client must consider to establish whether or not there is value for him in the WESRAC product are:

1. His cost versus probable yield.
2. The WESRAC price versus client cost to get the same material elsewhere.
3. Promptness of results.
4. Convenience.
5. Quality of results.

The case histories included as Appendix II show a number of examples where clients have found the WESRAC product to have value.

SERVICE AGREEMENTS AND FEES

The WESRAC program is outlined on the Agreement forms which are included in the report as Appendix III. There are three price levels based upon the number of searches anticipated by the client during the year. These are summarized below:

<u>Plan</u>	<u>Annual Commitment</u>	<u>Unit Search Charges</u>	
		<u>Retrosearch</u>	<u>Progress Search</u>
Standard	\$5,000	\$120	\$350
Limited*	\$2,500	\$165	\$375
Introductory**	\$1,000	\$190	\$400

* Convertible (retroactively on unit costs) to Standard Plan at any time.

** Convertible (retroactively on unit costs) to either Limited or Standard Plan within 4 months.

The Retrosearch is a retrospective search into the full NASA file for pertinent information on the client's problem or area of interest. The Progress (or Current Awareness) Search is for twelve monthly reports based on a search each month of new material added to the NASA file during the month on a single client problem or area of interest. Both types of searches include the services of a specialist from WESRAC who works with the client to achieve clear problem definition for efficient computer search and response.

Clients are requested to pay the annual commitment at the beginning of the year, and as each search is ordered, it is charged against the annual commitment at the stated unit price per search until the commitment is used up. Additional searches may be ordered at the same unit price specified in the client agreement.

One aspect of our service not shown in the agreement is our provision for complete documents which are required by the client. Earlier in the year, one copy of each document requested was provided free. Later, this was limited to five copies per search. However, because of the cost of full documents and the unpredictable size and volume of printed material needed by clients, a controllable specific number of pages is now provided as part of each search. One hundred pages are provided as part of each Retrosearch and three hundred are given with each Progress Search. Additional pages are 19¢ each, or microfiche will be provided at 75¢ each. If time is not important and printed documents are available from other sources, WESRAC will provide them at cost.

Prices have changed little during the year. However, at the beginning, only the Standard (\$5,000) Plan was offered. The lower commitments with higher unit costs were added later to cater to the needs of clients with fewer search requirements.

Prices have been established at WESRAC based upon the experience of other centers and the development of cost figures based upon a level of client participation expected in three years. Income was scheduled to cover costs of operation only on the assumption that NASA would continue to provide the information, computer tape, printed abstract and report support provided at the time of the establishment of WESRAC.

MARKETING

Marketing at WESRAC includes market delineation, sales, advertising, public relations, and all activities used to develop business. As previously noted, a disproportionate amount of marketing time and money is expended in the education or attempted education of organizations to the desirability of systematically using a service such as that provided by WESRAC to find out what has already been done before starting on one's own project.

The Market.

The market for WESRAC service is the West. It includes the seven Western States, Alaska and Hawaii. Potential clients continue to be manufacturing, mining, transportation, and public utilities. Emphasis is placed on non-aerospace industry, i.e., companies which do not have contracts with NASA. There are about 7,500 organizations of this type in the West with over fifty employees. There are about 600 with five hundred or more employees. It was established early that Southern California alone included over 3,000 organizations of the type we considered to be candidates having 50 or more employees. More than 250 of these have over 500 employees. While Southern California is heavily oriented toward government contractors and aerospace firms, it is also composed of a relatively high percentage of sophisticated, commercially oriented organizations which should use effectively the new ideas and innovations stored in the NASA bank, and provided by WESRAC.

NASA contractors are actually potential clients under certain conditions. For example, if there is a phase of WESRAC service which provides more effective results than the contractor can get through computer tapes provided to him by federal agencies or through free service from NASA sources, he may wish to use WESRAC service even on the NASA contract itself.

Further, very large segments of industry with NASA contracts are using only part of their resources for that work. Most wish to expand their commercial activities as much as possible. NASA tapes and services have been provided to them for use on NASA or specified federal contracts only. The temptation for them to utilize all of these benefits provided by federal contracts, not only for the federal (e.g., NASA, DOD, etc.) contracts, but also for their own commercial ventures, is very great. If this is done, it would appear to give such government contractors a competitive advantage not intended by Congress over other private industry in commercial areas where they are competing in the marketplace. WESRAC offers legitimate access to the great NASA bank and other sources for all companies in their commercial ventures.

WESRAC has spent its first fiscal year in developing marketing techniques and testing the marketplace for actual acceptance of the WESRAC product. Its work has been restricted to the area south of a line across California from Santa Barbara. At the same time, many contacts have been made in the San Francisco area, and a manager for the area tentatively selected. It was felt that work in Southern California where operations are most conveniently located near WESRAC headquarters would provide a training ground in which all problems could be solved prior to extension outside of this area.

Marketing Staff.

As of year end, the marketing staff consisted of a manager, two full-time salesmen, two half-time salesmen, two part-time sales assistants, one full-time secretary, and one half-time secretary. A change in Marketing management had been made to increase the emphasis on the marketing function and to bring new ideas into this critically important phase of WESRAC operation. It is expected that 1968 will see aggressive marketing action.

Sales Efforts and Promotion.

During the past year (to February 1, 1968), 513 organizations had been called on personally by sales representatives from WESRAC. Many had been called on several times. Over 1,200 phone contacts had been made in order to arrange appointments.

Direct mail has been used extensively. The names and addresses used came from a variety of sources. The initial mailing went to 350 prospective clients from a prime list and was used as a basis for a telephone follow-up to make an appointment. This and subsequent mailings are shown in Exhibit A on page 21.

Two brochures were developed during the year. Both are envelope size, but differ in color and composition. One is a fold-over type, while the other is a booklet type and has a companion mail-back card. These are included in Appendix IV. It will be noted that our first brochure (yellow) included a list of companies who were users in the East of services similar to WESRAC. We found that while this is important information to prospective clients, it changed too frequently to be reliable.

Advertising was used effectively during the year in the Wall Street Journal (Pacific Coast edition) four times, the Los Angeles Times, Los Angeles Herald-Examiner, and the USC Alumni Review, once each. A total of 125 replies

EXHIBIT A
SALES MAILINGS

Source of Names and Addresses	Number of Letters Mailed
Prime client list - for appointments	350
NASA Santa Monica office inquiries from business	152
USC Research Institute for Business and Economics address list	1,500
Professional Societies and Trade Organizations	17
Local Universities, Dir. of Gov't Grants	19
NASA, Jet Propulsion Laboratories Inquiries from business	38
NASA Tech Brief Users in the West	120
Los Angeles County Hospital Staff Association	86
Classified Telephone Directory	427
Engineers - Consulting	
Research - Electronics R&D	
Laboratories, Research	
Missile & Rocket R&D	
Space, R&D	
World Space Directory (sample)	208
Major Space & Oceanology Mfg.	
Component Space and Oceanology Mfg.	
Space & Technology Consultants & Special Services	
Major Non-Profit Research Organizations	
Professional Associations and Organizations	
Christmas Mailing--clients, prospects, associates	<u>300</u>
TOTAL	3,217

and leads were identified as being related to these advertisements. The Wall Street Journal was the most effective by far. Copies of the advertisement format used in all cases are in Appendix V.

Many non-paid publicity articles appeared during the year as a result of WESRAC contacts. These were either newsworthy items or were for the information of the readers. Some of these are listed in Exhibit B on page 23.

Very good coverage was also achieved on radio and television during the year. These shows are listed in Exhibit C on page 24.

An effort was made to evaluate all of the publicity by relating responses to specific types of publicity or sales promotion. However, this proved to be very difficult. As noted earlier, many responses were identified with the advertisements. Direct mail and the more general publicity produced very few identifiable responses.

New Technology Workshop Seminar.

The Marketing department was assigned the responsibility of producing and selling an experimental workshop seminar similar in many ways to the very successful User-Producer Conference of 1966. This was scheduled for Santa Barbara, California, at the Santa Barbara Biltmore for October 29th, 30th, and 31st, Sunday p.m. through Tuesday a.m.. This differed from the previous conference in that it was at a different time of the week, was longer, and the attendees were requested to pay for attendance. The charge was \$150.00, which covered rooms, meals and registration. The brochure, which lists a very fine program, is in Appendix VI.

EXHIBIT B

NEWSPAPER AND PERIODICAL ARTICLES CONCERNING WESRAC

Publication	Title (if used)
<u>Culver City Star News</u>	"NASA Enriches Non-Space Fields"
<u>Los Angeles Times</u>	"Data Bank Stores Knowledge for Everyman and his Enterprises"
<u>Design News</u>	"Space Technology Utilization: The Challenge to Creative Imagination"
<u>Los Angeles Times</u>	"USC to have Aerospace Research Bank"
<u>Los Angeles Times</u>	"Research Unit for Industry Opens at USC"
<u>Electronic News</u>	"USC Forms Aerospace Technology Data Bank"
La Habra-Brea <u>Star Progress</u>	"Research Application Center has Been Established at USC"
<u>Technology Week</u>	(no title)
<u>Chemical and Engineering News</u>	(no title)
<u>Van Nuys News</u>	"Information Bank at USC Will Help Industry"
<u>Douglas Airview News</u>	"USC Establishes Data Center"
<u>USC Items</u>	(no title)
<u>Engineer Scientist</u>	"USC, NASA Set Up Technical Research Center"
<u>USC Daily Trojan</u>	"Information Bank Claims to Know 'Almost Anything'"
<u>Western Electronic News</u>	"Bank of Technological Knowledge"

EXHIBIT C

TV AND RADIO FEATURING WESRAC
(plus related promotion)

Subject	Time	Media	Station	City
NBC News	5 min.	TV	KNBC	Los Angeles
Interview	30 min.	Radio	KFI	Los Angeles
Innovations --				
"Research by Computer"	30 min.	TV	KCET	Los Angeles
			KUED	Salt Lake City
*This show also is being shown outside			KEBS	San Diego
WESRAC territory in Washington, D.C.;			KVIE	Sacramento
St. Paul; Fargo, N.D.; Des Moines;			KIXE	Chico, Redding
Dallas; Albuquerque; Houston; Milwaukee;			KCTS	Seattle
St. Louis; Detroit and Chicago			KOAP,	
			KOAC	Portland
			KUCR	San Bernardino
			KWSC	Pullman, Wash.

ADVERTISING AND MAIL
PROMOTION FOR WESRAC TV AND RADIO SHOWS

For Radio Show - 30 minutes

Advertisement - Los Angeles Times "Can Your Company Operations Be Improved?"

For TV Show - Innovations - 30 minutes

Mail to prospective clients (220)

Mail to clients (51)

Advertisement - Los Angeles TimesAdvertisement - Los Angeles Herald-Examiner

Promotion for the workshop was intense, and at the end consumed almost three weeks of time for the entire Marketing staff. These efforts are shown in the following Exhibit D:

EXHIBIT D

PROMOTIONAL EFFORTS FOR WORKSHOP CONFERENCE SANTA BARBARA 29-31 OCTOBER 1967

<u>Promotional Efforts:</u>	<u>No. of Companies</u>
Personal Visits	34
Individually Addressed Letters	1,182
Brochures Distributed	3,258
Telegrams (Hand-Delivered)	139
Phone Calls to 451 Companies	866
 <u>Results:</u>	
Acceptances	18
Interested-Undecided	25

The results of such a massive promotional effort were considered to be very modest and because the number of firm responses were inadequate one week before the meeting to justify the excellent program assembled, a conference was held with the principal speakers and NASA Headquarters. The decision was made to postpone the conference to some future date.

An analysis of why this meeting did not receive greater response indicates that the main reasons seem to have been competition for time and competition with other similar meetings. Important near conflicts developed with AIAA, IEEE, and others who have a prior built-in acceptance from the type of attendee we were soliciting. However, subject matter and cost were also considered to be important. The after-action report prepared on this workshop effort will be used to set guidelines when similar seminars are attempted in the future.

Sales Results.

In the nine and one-half months during which WESRAC could actually offer service to Western industry, twenty-nine clients had signed and accepted agreements. Four additional clients had signed agreements which had not yet been delivered to WESRAC. Of the 29, 24 were fully paid, 3 were partially paid, and the 2 most recently acquired clients were unpaid. One additional client had received service for which he paid without an agreement. WESRAC has experienced no failure-to-pay problems.

Relating total personal contacts to clients obtained, it appears that about 6% of the prospects called upon become clients. However, as experience is acquired in selling the product, as knowledge of the WESRAC service becomes more generally known, and as the record of successful use of results accumulates, it is anticipated that this yield will increase.

ENGINEERING AND SCIENTIFIC APPLICATIONS

The second department in WESRAC, Engineering and Scientific Applications, is composed of a manager, secretary, and a number of part-time engineers and scientists varying according to need from five to ten. The main purpose of this group is to monitor the work desired by a client and to provide the personal service for which WESRAC is charging.

The WESRAC product has been discussed previously. Our objective is to provide specific answers to client problems and to help the client put to his own use the results of other work in his area of interest as readily as possible. Giving him large numbers of reports from which he must filter out useful material discourages any search at all. Our method includes doing much of this screening for him.

When a client indicates a need for a search, WESRAC assigns a specialist from the Engineering and Scientific Applications group who understands the area of the client's interest and its terminology. He discusses the problem with the client and they produce a refined definition. It is at this point that an extra dividend is afforded the client because occasionally he is not completely clear on how to attack his problem. This client discussion with a knowledgeable second party may put it in a new focus. At the same time, WESRAC now has a man "in house" who knows what the client is looking for and can monitor the search at WESRAC.

The definition developed is now used to phrase the computer search for the WESRAC Information Systems group. The results of this search are received by the Specialist in the form of abstracts. He screens these, selects those which are pertinent and returns them to Information Systems for inclusion in

the report to the client. The client evaluates the relatively few abstracts sent to him, decides which ones represent full documents he would like to have, and orders them. If he questions why some of the abstracts have been selected, our Specialist is ready to discuss the logic he used. Further, when the need is obvious, our Specialist will make manual searches in the library or in other source material to expand the assistance the client gets from WESRAC.

Except for the Manager, the Engineering and Scientific Applications staff is made up primarily of graduate students and secondarily of faculty members and outside consultants for special problems. Very well experienced men have been available during this year, most of whom have not only an excellent educational background, but also actual experience in business.

One of the strong points of WESRAC association with a University having a large sophisticated Engineering School has been the reservoir of skills available for short-term use. Full-time employment of all the skilled people used would be economically unfeasible. Of course, part-time employment has some weak elements. For example, the intermittent use of a particular individual reduces his involvement with WESRAC which must be number two in priority for his time. He does not have the same feeling of responsibility toward goals which a full-time employee has. Also, on occasion he is not available when needed. Further, intermittent employment, coupled with turnover of part-time people means a continuing training program. These are extra time consuming management problems. Good leadership for this department is important because of the caliber of the individuals in the department and their transient nature.

The Scientific and Engineering group is WESRAC's main contact with clients. The members of this group deal with the actual users in the client

organization, and, so far as the client is concerned, are WESRAC. They are responsible for the quality of work performed and know how much use is being made of the service. That they have been reasonably successful up to date is illustrated by client response to the work performed. (See Testimonials, Appendix VII.)

Because of a tendency by clients to buy WESRAC service for a specific project and because of the difficulty of reaching other individuals at the use level in a company, a client manual has been designed for distribution at the user level of a company. This manual suggests ways of using WESRAC, how we work, and how to implement a request. It will be of convenient handbook size and quality to encourage retention by potential users. This manual also has obvious marketing value for contact with potential new client companies. It is scheduled for completion in early April.

Monthly status reports to clients are a part of WESRAC service. (See Appendix VIII.) This report specifies the period left on the contract and indicates how much of the service in dollars has been used up. It gives WESRAC a continuous contact with the client and keeps both client and WESRAC up-to-date on the current status of service with the client.

Forms used by the Engineering and Scientific Applications department to accomplish their mission most effectively are enclosed as Appendix IX with other forms used by WESRAC. The headings of these forms indicate their use.

This group at the present time is expending extra effort, time and money to please clients on the theory that only service which a client recognizes as valuable will result in continued use of WESRAC service. However, costs are continually being evaluated in order to keep them at practical levels.

The following items are factors to be controlled:

1. Travel time to clients.
2. Consultation time.
3. Manual searches vs. less expensive computer searching.
4. Assignment of specialists to clients who have skills needed but are not excessively qualified.
5. Development of tight strategies to avoid non-essential computer print-out and screening by specialists.

Effectiveness of the Engineering and Scientific Applications group is measured by:

1. Personal contact with client.
2. Number of documents ordered.
3. Testimonials.
4. Number of search requests.
5. Repeat business.
6. Technology transfers achieved.

INFORMATION SYSTEMS

Information Systems is the third of WESRAC's major departments. Its basic function is to provide service to the Engineering and Scientific Applications group and the Marketing group. It is custodian of all information files, microfiche, computer tapes, full reports and abstracts. It is responsible for all production of reproduced material, reports for clients, documents requested by clients, programming, and computer searches.

The staff required for this department consists of two full and five half-time employees.

The computer continues to be an IBM 1401 with four fast tape drives. Our computer tape format is part linear and part inverted, which makes it possible to conduct a competent search in one-fourth the time required by the program originally provided to us. Effectiveness of this searching has been tested against search techniques at another center and produced twice as much relevant material with little increase in irrelevant material.

The computer used is part of the equipment in the Graduate School of Business with which WESRAC is connected. We operate this computer ourselves for convenience purposes and have a regular daily period of use assigned in addition to an opportunity to use it at night when necessary. In addition to this, arrangements have been made with outside sources to utilize a commercial computer in case of an emergency. Our program has been tested on a new computer, Model IBM 360-40, and this machine can be used most economically when necessary.

Major special equipment utilized by Information Systems, in addition to the computer, are Filmac 400B and a Xerox 914.

An example of the report format produced for clients is shown in Appendix IX.

Effectiveness of the Information Systems group is primarily based upon promptness of delivery, quality of work, and operation cost control. These are monitored continuously and appear to be excellent.

PROGRAM REVIEW

WESRAC was the subject of a detailed evaluation by NASA Technology Utilization Division officials toward the end of the contract year. This visit was preceded by adequate notice and a suggested agenda outlining the many items which would be examined or about which information was desired. This effective handling made it possible to conduct an efficient examination without waste of time. It also caused WESRAC to stop and look at itself systematically from a variety of viewpoints.

The results of this review were advantageous to WESRAC and appear to have been useful to NASA Headquarters people. Methods of operation and ideas picked up from WESRAC which appear to be useful in other areas generally can be passed on while, at the same time, WESRAC received benefits from visits by the NASA representatives to other centers. This interchange would appear to create better understanding and operation in the whole Regional Dissemination Center network.

ACORDD

During the year, an organization was created entitled Action Council of Regional Dissemination Directors with the acronym ACORDD. This brought together for cooperative and united action all NASA Technology Dissemination Centers. The meetings, being held on a quarterly basis, provide an opportunity to share experience, problems, and solutions.

Joint efforts to obtain economic efficiency by enjoying the advantages of consolidated, large-scale operations have begun in ACORDD. Further, efforts are being made to enlarge the information base available to centers and to develop a working relationship with other organizations having information banks covering additional areas not included in the files at NASA centers.

YARDSTICKS OF SUCCESS

The objective of a NASA Regional Technology Dissemination Center is, basically, to disseminate the technology accumulated as a result of the Space Program to the non-NASA related sector of the economy. This places in the hands of business and industry all the new ideas, products, and ways of doing things which have resulted from the billions of dollars spent on the Space Program. While this material can be obtained directly from NASA published indexes, it is provided by WESRAC on a much more sophisticated basis, with searches directed specifically to industry needs. It includes computer searching in depth of the NASA file plus other sources.

Each Regional Dissemination Center for Technology is, in fact, held responsible for pushing into the hands of industry these technology advancements by making aggressive solicitation of industry to use the service. Because this program is not intended to be a perpetual government handout, each center is required to charge enough in fees from its patrons to cover expenses of operation and to reach this point of self-sufficiency in not over five years. Acceptance of the Technology Dissemination program by industry as evidenced by sufficient financial patronage to pay the expenses of a center has been termed the yardstick of success.

It has been found, however, that industry does not, in fact, line up to obtain the information provided in the NASA bank of technology and probably not from other large files of information either. Automatically utilizing what has already been done by somebody else in order to avoid duplication of effort and to get new ideas does not appear to be part of the American habit, regardless of price for the product. This new development, easy economical access to large masses of technology information, has not as yet been recog-

nized as an economic gold mine by business and industry.

While WESRAC service has not yet had a full year to season, several clients have testified favorably to its results. However, at least one client has purchased the WESRAC program, and after seven months, has failed to use it once. There is only one way for the WESRAC product to be evaluated, and this requires use. Serious attention is being given to this phase of WESRAC operation, which is critical to the continuation of a technology dissemination program and to continued success for WESRAC.

Reaction to the WESRAC product is almost invariably favorable by management, which views it from a company-wide point of view. The NASA file has the best potential use for organizations that recognize the broad range of subjects covered. However, the apparent usual tendency is to buy the service only when a specific project has a need and to then assign the WESRAC contract to that project. This restricts application to other phases of company activity.

The other principal tendency is to treat the service as a purely library function. At this point, there is usually some problem with organizations which are large enough to operate their own library because the librarian tends to consider the WESRAC service as a competitor rather than as an addition to her service. Further, the best results from the WESRAC product can only be obtained by direct contact between the WESRAC specialist and the individual in the company who needs the service. It cannot be done best by filtering requests through a third party, such as a librarian.

The hours required to educate users on the application of technology performed by others appears to be the most serious problem in the transfer of

technology. This requires a change in habits that seem to be thoroughly ingrained. It does not appear that individuals in business, and particularly skilled scientific and engineering people, have the habit of investigating a problem to see if an answer has already been found before starting in to do it themselves.

It seems that a disproportionate number of NASA dollars are being spent for the education of industry on actually using the accumulated technology rather than merely making it efficiently available. The question might be asked as to whether or not the educational phase is really part of the NASA responsibility. Certainly the location of the dissemination centers at universities implies an opportunity to bring these ideas to new scientific, engineering, and business graduates. However, this does not cover the need for education in established industry and results must be slower.

It would appear that the impact of the NASA technology on industry cannot be measured fully by either income at dissemination centers or dramatic transfers from the space effort to commercial use. American industry as a whole cannot fail to feel the impact of continuous contact by representatives and publicity from NASA centers to use what's been done before, to avoid needless duplications of expensive effort, to take advantage of improvements in ways of doing things and in adapting new products which are available almost for the asking to commercial use.

CONCLUSION

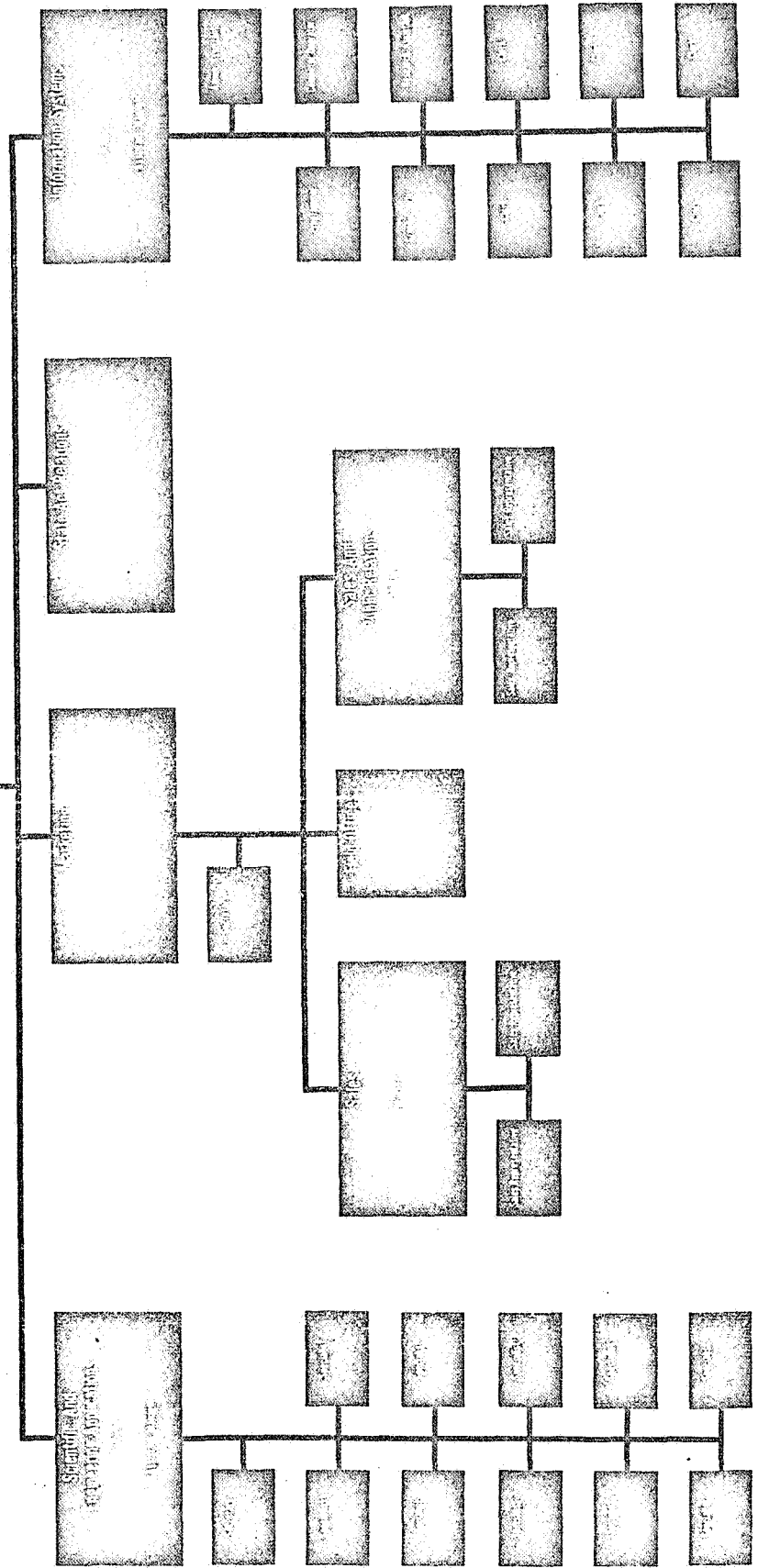
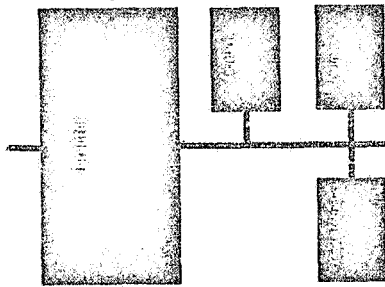
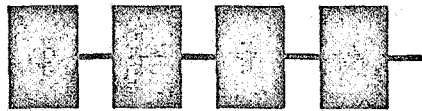
To quote NASA officials who have evaluated WESRAC progress during its initial year, "WESRAC is off to a strong start." Problems have been many, despite full utilization of experience in other centers. Personnel are a continual factor and its quality will control WESRAC performance.

Client satisfaction has been expressed in various areas, but the real tests are still to come--renewals and financial self-sufficiency. However, educational processes for industry to use NASA technology absorb such a high percentage of the NASA investment in getting a center established, some question might be raised on self-sufficiency as a final evaluation of NASA's true contribution to and impact on the economy.

APPENDIX I

ORGANIZATION CHART

Western Research Application Center



APPENDIX II

CASE HISTORIES

Fourteen examples of application
by WESRAC clients of technology acquired
from searches made by WESRAC of the NASA
file.

APPENDIX II

WESRAC CLIENT CASE HISTORIES

Client 11

Client is a manufacturer of display systems. Client anticipated far-reaching changes in his customer's specifications. In order to be prepared when these changes might appear, client used WESRAC's services to familiarize himself with advanced work being done on display systems having far more rigid specifications regarding strength under high temperature conditions. When change of specifications was submitted by major customer, client was prepared.

Suggestions from WESRAC Specialists provided related ideas and material which stimulated client to consider new approaches to related problems.

Client 12

Client received a contract for making a study in depth of various aspects of urban transportation. In conjunction with client's scientists and engineers, WESRAC Specialists produced documents on advanced technology including power transmission, nuclear propulsion, batteries and fuel cells, combustion cycles, advanced traffic control systems, new tunneling techniques, tire technology, self-adjusting spring systems, etc.

The technical documentation supplied by WESRAC formed the raw base for the final project report.

Client 16

This client is an old-line company making a concrete product which has not changed much through the years. The company is now experimenting with a

(Appendix II, continued)

concrete product using resin as a binder instead of cement. WESRAC provided the client with information to bring him abreast of the latest in the field. The client intends to bring out a new line of concrete products for approximately the same price as his conventional line; however, the new product will be superior in strength, wearing ability, and resistance to chemicals.

In addition, WESRAC produced valuable information on another project for which the client is seeking an inexpensive substitute for pipe. The technology of filament wound vessels, composite materials, and sandwich construction was presented to him. The client is now developing new products along these lines.

Client 17

The client had a problem of isolating an interior compartment from the noise of rotating equipment. WESRAC's Specialists presented him with information on advanced acoustic insulation through evacuated panels. Client is using this data in the interior design of a helicopter.

Client 19

Client was awarded contract to study behavior of people confined in close quarters over a long period of time and to program rest and recuperating activities of the people. Client made a literature search using own personnel and facilities but was not completely satisfied with results. WESRAC's Specialist, a psychology expert in stress of human beings under long-term conditions, was assigned to program a search which would produce all pertinent literature on the subject. WESRAC's search proved to be many times more effective than the client's own search.

The depth and breadth of the advanced research documents produced by

(Appendix II, continued)

WESRAC won an unsolicited letter of commendation from the client for WESRAC and the personnel involved in this project.

Client 21

Client is a leader in the controls field for consumer and industrial products. Although product line has been updated regularly, client's engineers were not cognizant of the advanced development in controls which has been produced in aerospace.

Through a series of searches for pertinent new technology, WESRAC's Specialists were able to furnish client with technical documents and reports on those developments in aerospace controls which might be advantageous and utilized in the client's own product lines. The client's engineers are now redesigning various products to incorporate adaptation of this new technology.

Client 22

Client is a large division of one of the largest metal producers in the country. The division has never been particularly profitable. Because of large military contracts, client has been extremely busy the past two years and making a profit. The division management fears that when conditions return to normal, company headquarters will order the division shut down.

Division management has called upon WESRAC to help, during the war-inspired profitable years, to prepare other possible product lines which might be pursued upon the war's cessation. WESRAC Specialists have furnished division management documentation on fabricating titanium which, it is felt, can be done utilizing on-hand equipment. Also, WESRAC's Specialists have

(Appendix II, continued)

presented division management with documentation on advanced methods of metal forming for aluminum and steel.

With this and other information which WESRAC will be submitting to him, client hopes to be better prepared to enter new and profitable fields when present conditions become normalized.

Client 23

Client had a problem involving electronic sensors to position trains for an automatic material handling system. Client's own scientists and engineers were not familiar with advanced technology in this field. WESRAC's Specialist, an expert in this field, was able to help the client solve his problem with the documented technology obtained from the NASA Data Bank. Information was provided on sensors as well as their utilization in systems.

Client 25

This client is one of the major utilities companies in the West. Client has been furnishing non-toxic natural gas to its customers for years. However, occasionally a complaint is received from a customer of possible personal health damage which he attributes to the gas. In order to substantiate the client's understanding of the gas toxicity, WESRAC was asked to produce reference literature on this subject. With this documentation, client can now answer complaints more authoritatively.

WESRAC also helped client with regard to new methods for removing dirt, rust, old paint, and corrosion from company's meters. These meters are often in exposed locations or buried in the ground for periods up to 18 years. Meters are then brought in to company's yards for cleaning and

(Appendix II, continued)

repainting. Material presented by WESRAC is currently being studied by client to determine how best to be applied to problems at hand.

Client 26

Client is a large manufacturer of semi-conductors. A member of his staff is to present a general survey paper on semi-conductors before a technical society. WESRAC was called upon to provide the documentation and reference literature which will be used as the basis for this paper. WESRAC's efforts saved staff member's valuable time and effort allowing him to continue with his normal duties instead of taking several weeks for a thorough literature search.

Client 28

Client is a major world-wide engineering contractor. They build huge chemical plants. A major problem of the client is to keep the noise from plant equipment at a level acceptable to adjacent communities. WESRAC was called upon to conduct a search for new technology methods which might be used for acoustic shielding of noise producing plant equipment. The client will use applicable methods on a trial basis.

Client 35

Client is a large manufacturer involved in advanced systems. In support of its product development program, client conducts a large number of research projects. Client is uncertain whether some of these research projects are a duplication of work already done before. To avoid any unnecessary duplication of work already accomplished in the particular field, a scientific and engineering document search has been ordered for each of the

(Appendix II, continued)

planned research projects. When the searches are concluded, the client will be in a position to realistically evaluate the utility and direction the planned research projects should take.

Client 39

Client has been concerned in the past with vibration as it related to environmental testing. Client wanted to expand his product line within the vibration field. WESRAC's specialists provided numerous new ideas ranging from machining processes to medical instrumentation.

Client 40

Client is a small company in the power supply business. At client's request, WESRAC specialists conducted several searches which produced solutions to manufacturing problems as well as technical documentation on new circuitry, miniaturization, etc., applicable to client's product line.

APPENDIX III

WESRAC CLIENT AGREEMENT FORMS

- A. Standard Plan (Annual Commitment \$5000)
- B. Limited Plan (Annual Commitment \$2500)
- C. Introductory Plan (Annual Commitment \$1000)
- D. Conversion Option

WESTERN RESEARCH APPLICATION CENTER

WESRAC PROGRAM PROPOSAL

STANDARD PLAN

The Western Research Application Center (WESRAC), a Division of the University of Southern California, proposes to provide a technology dissemination service known as the WESRAC Program, for:.....

.....
the client, commencing on date of client's acceptance, and continuing in effect from year to year until cancelled in writing by either party prior to the commencement of the succeeding year.

The following services will be charged against the annual client fee:

1. RETRO-SEARCH (\$120 per search) — AN INDIVIDUALLY DESIGNED RETROSPECTIVE COMPUTER SEARCH OF THE NASA DATA BANK AND OTHER SOURCES. Steps taken to perform this search are as follows: Client specifies his general problem or area of interest. WESRAC specialist (engineer or scientist) helps client define the search area. A computerized screening of the NASA Data Bank (currently in excess of 300,000 documents) is made. WESRAC evaluates the findings and provides two copies of abstracts of all pertinent documents. WESRAC specialist discusses material provided, if desired.

In addition to these services, client may select 100 pages of full documents referred to in the abstracts for each search at no charge. Additional pages will be provided at 19¢ a page on request.

2. PROGRESS SEARCH (\$350 per year) — AN INDIVIDUALLY DESIGNED COMPUTER SEARCH PERFORMED MONTHLY FOR A YEAR ON NEW ADDITIONS TO THE NASA DATA BANK. Steps taken to perform this search are as follows: Client specifies his general problem or area of interest in which continuing awareness of new technology is desired. WESRAC specialist (engineer or scientist) helps client define the search area. Every month a computerized screening of new additions to the NASA Data Bank (over 6,000 per month) is made. After each screening, WESRAC evaluates the findings and provides two copies of abstracts of all pertinent documents. WESRAC specialist discusses material provided, if desired.

In addition to these services, client may select each year 300 pages of the full documents referred to in the abstracts at no charge. Additional pages will be provided at 19¢ a page on request.

3. SEMINARS AND WORKSHOPS (participation fees to be announced)
Member clients may designate representatives to attend WESRAC seminars and workshops on subjects to be announced periodically.

The annual client fee is \$5,000 to be paid on receipt of WESRAC's statement. Retro-searches, Progress Searches, Seminars and Workshops are charged during the year against this \$5,000 commitment in any combination desired by client up to the total annual fee. Unused portions of the annual fee may not be applied to succeeding service years. Client may request additional searches beyond the basic commitment at listed unit prices. Unused portions of the annual fee may not be applied to succeeding service years.

Neither NASA nor WESRAC represents that it has the right to make, use or sell inventions disclosed, or that the practice of inventions disclosed in NASA-furnished information will not infringe outstanding patents owned by third parties.

Acceptance by the client and the University of Southern California, as evidenced by signatures below, shall constitute an agreement between the parties.

ACCEPTED:

.....

By.....

Date.....

UNIVERSITY OF SOUTHERN CALIFORNIA

By.....

Date.....

A. Kendell Oulie, Director

WESTERN RESEARCH APPLICATION CENTER

Unless accepted, this proposal expires

WESTERN RESEARCH APPLICATION CENTER

WESRAC PROGRAM PROPOSAL

LIMITED PLAN

The Western Research Application Center (WESRAC), a Division of the University of Southern California, proposes to provide a technology dissemination service known as the WESRAC Program for:.....

the client, commencing on date of client's acceptance, and continuing in effect from year to year until cancelled in writing by either party prior to the commencement of the succeeding year.

The following services will be charged against the annual client fee:

1. RETRO-SEARCH (\$165 per search) — AN INDIVIDUALLY DESIGNED RETROSPECTIVE COMPUTER SEARCH OF THE NASA DATA BANK AND OTHER SOURCES. Steps taken to perform this search are as follows: Client specifies his general problem or area of interest. WESRAC specialist (engineer or scientist) helps client define the search area. A computerized screening of the NASA Data Bank (currently in excess of 300,000 documents) is made. WESRAC evaluates the findings and provides two copies of abstracts of all pertinent documents. WESRAC specialist discusses material provided, if desired.

In addition to these services, client may select 100 pages of full documents referred to in the abstracts for each search at no charge. Additional pages will be provided at 19¢ a page on request.

2. PROGRESS SEARCH (\$375 per year) — AN INDIVIDUALLY DESIGNED COMPUTER SEARCH PERFORMED MONTHLY FOR A YEAR ON NEW ADDITIONS TO THE NASA DATA BANK. Steps taken to perform this search are as follows: Client specifies his general problem or area of interest in which continuing awareness of new technology is desired. WESRAC specialist (engineer or scientist) helps client define the search area. Every month a computerized screening of new additions to the NASA Data Bank (over 6,000 per month) is made. After each screening, WESRAC evaluates the findings and provides two copies of abstracts of all pertinent documents. WESRAC specialist discusses material provided, if desired.

In addition to these services, client may select each year 300 pages of the full documents referred to in the abstracts at no charge. Additional pages will be provided at 19¢ a page on request.

3. SEMINARS AND WORKSHOPS (participation fees to be announced)
Member clients may designate representatives to attend WESRAC seminars and workshops on subjects to be announced periodically.

The annual client fee is \$2,500 to be paid on receipt of WESRAC's statement. Retro-searches, Progress Searches, Seminars and Workshops are charged during the year against this \$2,500 commitment in any combination desired by client up to the total annual fee. Unused portions of the annual fee may not be applied to succeeding service years. Client may request additional searches beyond the basic commitment at listed prices. The client may at his option at any time during the service year, convert to the Standard Plan.

Neither NASA nor WESRAC represents that it has the right to make, use or sell inventions disclosed, or that the practice of inventions disclosed in NASA-furnished information will not infringe outstanding patents owned by third parties.

Acceptance by the client and the University of Southern California, as evidenced by signatures below, shall constitute an agreement between the parties.

ACCEPTED:

By.....

Date.....

UNIVERSITY OF SOUTHERN CALIFORNIA

Date.....

By.....

A. Kendell Oulie, Director

WESTERN RESEARCH APPLICATION CENTER

Unless accepted, this proposal expires:

WESTERN RESEARCH APPLICATION CENTER

WESRAC PROGRAM PROPOSAL INTRODUCTORY PLAN

The Western Research Application Center (WESRAC), a Division of the University of Southern California, proposes to provide a technology dissemination service known as the WESRAC Program, for:.....

.....
the client, commencing on date of client's acceptance, and continuing in effect from year to year until cancelled in writing by either party prior to the commencement of the succeeding year.

The following services will be charged against the annual client fee:

1. RETRO-SEARCH (\$190 per search) — AN INDIVIDUALLY DESIGNED RETROSPECTIVE COMPUTER SEARCH OF THE NASA DATA BANK AND OTHER SOURCES. Steps taken to perform this search are as follows: Client specifies his general problem or area of interest. WESRAC specialist (engineer or scientist) helps client define the search area. A computerized screening of the NASA Data Bank (currently in excess of 300,000 documents) is made. WESRAC evaluates the findings and provides two copies of abstracts of all pertinent documents. WESRAC specialist discusses material provided, if desired.

In addition to these services, client may select 100 pages of full documents referred to in the abstracts for each search at no charge. Additional pages will be provided at 19¢ a page on request.

2. PROGRESS SEARCH (\$400 per year) — AN INDIVIDUALLY DESIGNED COMPUTER SEARCH PERFORMED MONTHLY FOR A YEAR ON NEW ADDITIONS TO THE NASA DATA BANK. Steps taken to perform this search are as follows: Client specifies his general problem or area of interest in which continuing awareness of new technology is desired. WESRAC specialist (engineer or scientist) helps client define the search area. Every month a computerized screening of new additions to the NASA Data Bank (over 6,000 per month) is made. After each screening, WESRAC evaluates the findings and provides two copies of abstracts of all pertinent documents. WESRAC specialist discusses material provided, if desired.

In addition to these services, client may select each year 300 pages of the full documents referred to in the abstracts at no charge. Additional pages will be provided at 19¢ a page on request.

3. SEMINARS AND WORKSHOPS (participation fees to be announced)

Member clients may designate representatives to attend WESRAC seminars and workshops on subjects to be announced periodically.

The annual client fee is \$1,000 to be paid on receipt of WESRAC's statement. Retro-searches, Progress Searches, Seminars and Workshops are charged during the year against this \$1,000 commitment in any combination desired by client up to the total annual fee. Unused portions of the annual fee may not be applied to succeeding service years. Client may request additional searches beyond the basic commitment at listed unit prices. The client may at any time within a 4-month period from the date of the acceptance of this proposal convert to either the Standard Plan or the Limited Plan.

Neither NASA nor WESRAC represents that it has the right to make, use or sell inventions disclosed, or that the practice of inventions disclosed in NASA-furnished information will not infringe outstanding patents owned by third parties.

Acceptance by the client and the University of Southern California, as evidenced by signatures below, shall constitute an agreement between the parties.

ACCEPTED:

.....

By.....

Date.....

UNIVERSITY OF SOUTHERN CALIFORNIA

A. Kendell Oulie, Director
WESTERN RESEARCH APPLICATION CENTER

By.....

Unless accepted, this proposal expires

Date.....

WESTERN RESEARCH APPLICATION CENTER

CONVERSION OPTION

WESRAC's Introductory Plan may be converted to either the Standard Plan or the Limited Plan at the option of the client in accordance with the terms of the Introductory Plan agreement.

The new Plan becomes effective retroactively on the date that the Introductory Plan was accepted. Charges for services already performed will be recomputed at the lower fees contained in the new Plan selected by the client. Comparative fees for all three WESRAC Plans are:

WESRAC PLAN		*FEES FOR INDIVIDUAL SERVICES		
ANNUAL MINIMUM COMMITMENT		RETRO SEARCH (search of entire Data Bank)	PROGRESS SEARCH (monthly current awareness on a subject)	SEMINARS (of interest to clients)
Standard	\$5,000	\$120 each	\$350 per year	at cost
Limited	2,500	165 each	375 per year	at cost
Introductory	1,000	190 each	400 per year	at cost

*Fees for individual services apply against annual minimum commitment.

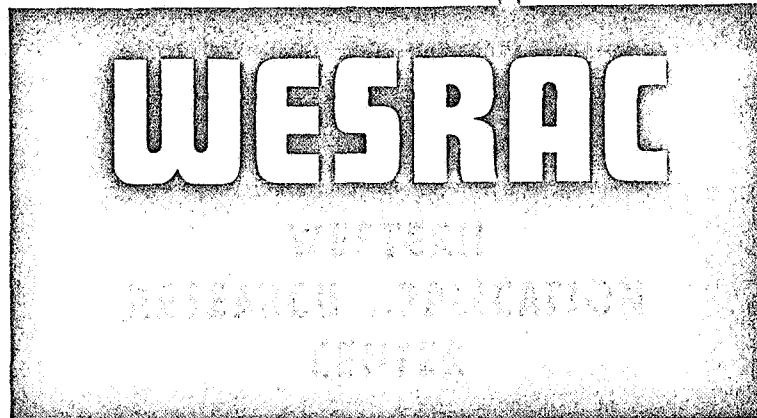
APPENDIX IV

MARKETING BROCHURES

- A. Yellow - First Half 1967
- B. Green - Current
- C. Reply Card for Inquiries

*To strengthen the
bridge between
technical research
and marketable
end use*

**NOW
YOUR COMPANY
CAN BENEFIT
FROM U.S.
AND FOREIGN
RESEARCH AND
DEVELOPMENT
ACHIEVEMENTS**



**A DIVISION OF USC RESEARCH INSTITUTE
FOR BUSINESS AND ECONOMICS (USCRIBE)**

*University of Southern California
Graduate School of Business Administration*

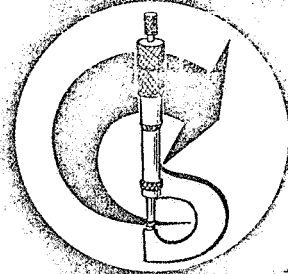
*In Cooperation With
National Aeronautics and Space
Administration (NASA)*

**WHY DO
IT ALL OVER
AGAIN?**

Why spend time and money in engineering and research that's been done before?

WEST's engineering and research work is being carried on today. Your needs can be put to

use through design, the development of product. If you are ever stuck or have worked on before by somebody



The Western Research Application Center of the University of Southern California was established to help private industry benefit from the billions of dollars that have been spent in recent years in research and development in all branches

**WESTERN RESEARCH
APPLICATION CENTER**

WESRAC

UNIVERSITY OF SOUTHERN CALIFORNIA
LOS ANGELES, CALIFORNIA 90007

Yes, I am interested in learning more about WESRAC and, in particular, how it can be of service to our organization. I understand there is no obligation.

NAME _____ TITLE _____

COMPANY _____

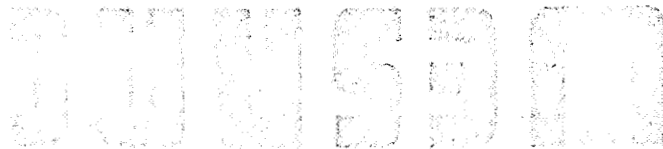
ADDRESS _____

CITY _____ STATE _____ ZIP _____

TELEPHONE _____

Remarks: _____

UNIVERSITY OF SOUTHERN CALIFORNIA
LOS ANGELES, CALIFORNIA 90007



APPENDIX V

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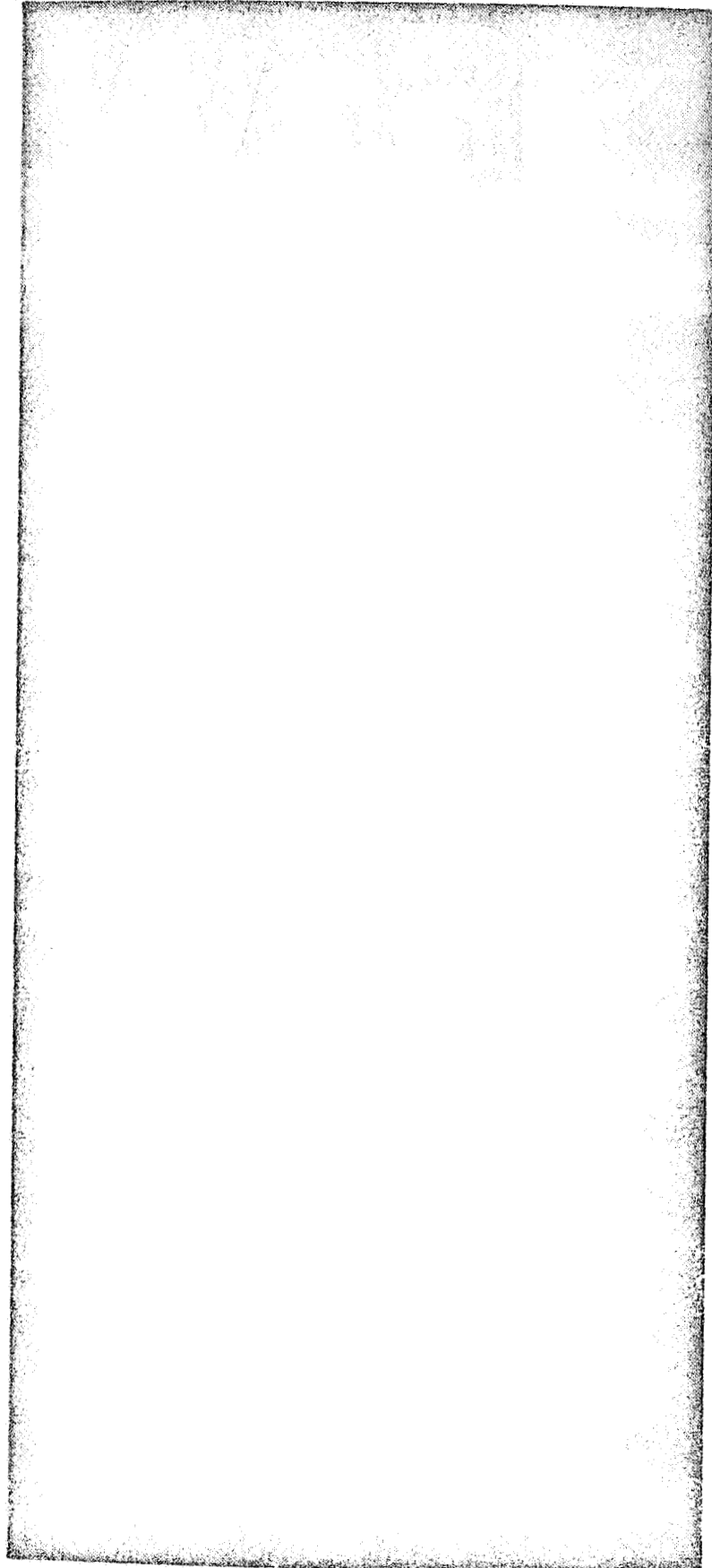
Finding specific answers to your specific problems is the dilemma. With help from NASA, the non-profit Western Research Application Center at USC's Graduate School of Business Administration has this information on computers to help your business get these specific answers fast and at low cost. And it has specialists who talk the language of your specialist.

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APPENDIX VI

BROCHURE AND PROGRAM FOR 1967 WORKSHOP SEMINAR



APPENDIX VII

TESTIMONIALS

- A. Serendipity Associates
- B. Robertshaw Controls



serendipity associates

Los Angeles Facility

9760 Cozycroft, Chatsworth, California 91311 / 213 341-0033

September 27, 1967

Mr. Milton A. Karp, Manager
Scientific & Engineering Applications
Graduate School of Business Administration
University of Southern California
Los Angeles, California 90007

Dear Mr. Karp:

I would like to go on record by indicating that the retrospective literature search conducted by WESRAC was greeted with a great deal of enthusiasm by Serendipity Associates. I have spoken with Dr. John Eberhard, director of the project, and he indicated that the output product is of great value to him. The cost effectiveness of your service was amply demonstrated.

I would especially like to commend Mr. William Holt and Mr. Bruce Sutkus for their aggressiveness and skill in meeting our requirements. It is my hope that this has been the first of many mutually beneficial searches.

Sincerely,

James L. Costanza, Ph.D.
Technical Manager
Los Angeles Facility

JLC:dp



ROBERTSHAW CONTROLS COMPANY

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ANAHEIM, CALIFORNIA

92803

AERONAUTICAL AND INSTRUMENT DIVISION

ANAHEIM, AREA CODE 714-TELEPHONE 535-5151 • LOS ANGELES, AREA CODE 213-TELEPHONE 628-5144 • CABLE ADDRESS-ROBERTSHAW

February 5, 1968

Western Research Application Center
809 West 34th Street
Graduate School of Business Administration
University of Southern California
Los Angeles, California 90007

Attention: Mr. James H. Gormsen, Marketing

Gentlemen:

In a product-oriented company, research receives a lower priority than new product development. It is also true, however, that the successful introduction and sale of a product in the market place is directly related to the worth of the operating principle and the neatness of execution. As a result of this apparent conflict, we are always looking for a bargain in spending our research dollar and feel that you have provided such with your literature searches.

Much time and money can be lost in the reinvention of the wheel, and we feel that you have saved us several thousands of dollars in avoiding redundant effort.

Very truly yours,



L. T. Garnett
Director of Engineering

LTG:bls

APPENDIX VIII

FORMS USED AT WESRAC

A list of all forms, by title,
now used at WESRAC and examples of
selected forms:

- a. Invoice Statement
- b. Client Status Report (Monthly)
- c. Marketing Call Report
- d. Engineering Search Information Sheet
- e. Marketing Client Data Record

FORMS CURRENTLY IN USE AT WESRAC
AND THEIR SOURCE
February, 1968

<u>Subject</u>	<u>Form No.</u>
NASA	
Client Subscription/Attrition Report	None
Tape Usage Report (Monthly)	None
UNIVERSITY	
USC Time Report	5204
USC Report of Expenditures	0307
USC Department of Labor Distribution Summary	5205
USC Hourly Rate Authorization	5230
USC Department Order--Invoice	0311
USC Requisition	0301
WESRAC ADMINISTRATIVE	
Action Slip	A797
Circulation Slip	A897
Invoice/Statement	A997
WESRAC Personnel Data Sheet	A128
Vacation Schedule	A228
Client Status Report (Monthly)	A328
Secrecy Agreement	A428
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ENGINEERING AND SCIENTIFIC APPLICATIONS	
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Engineering Search Time Summary	E267
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Search Work Request (Instructions to Systems re Printouts)	E628
Search Information Sheet	E728
Engineering Man-Hours Charged to Searches	E828
Client Search Status Sheet	E928
Search Status Report (Weekly)	E1028

(Forms Currently in Use--Continued)

<u>Subject</u>	<u>Form No.</u>
MARKETING:	
Client and Prospective Client Contacts (Weekly)	M177
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"We Value Your comments" Card for Clients	M367
Client Data Record	M477
Call Schedule (Weekly)	M597
Client and Prospective Client Contact Chart	M697
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Limited Plan	M818
Standard Plan	M918
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INFORMATION SYSTEMS

Systems - Time Sheet by Search	S157
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Request for Documents (Shipping Invoice)	S728
Request for Documents (No Charge)	S828
Xerox Use Log	S928



Example of Invoice Statement

WESTERN RESEARCH APPLICATION CENTER

The John Doe Company
12 East First Street
Los Angeles, California

Attention: Mr. John Doe

Reference: Western Research Application Center _____ (Name of Plan)
Per Agreement Signed _____ (Date)

STATEMENT

For Services Being Rendered
In Accordance with Above Referenced Agreement (Amount)

Payment due upon presentation of statement
Please make check payable to: University of Southern California
Mail to:

Western Research Application Center
University of Southern California
809 West 34th Street
Los Angeles, California 90007

(Signature of Director)



WESTERN RESEARCH APPLICATION CENTER

To:

Period Ending:

Our reference no.:

Your P.O. no. :

Your Agreement
expiration date:

Attention:

This will summarize the services requested by and remaining to your company in accordance with your current WESRAC Program Agreement:

SERVICES ORDERED				
	QUANTITY		FEES	
	LATEST MONTH	YEAR TO DATE	LATEST MONTH	YEAR TO DATE
Retro-searches				
Progress Searches				
Seminars				
Special Services				
Total				

YEAR TO DATE SUMMARY:

Total Contracted Services \$
Less Services Requested to Date

Value of services remaining

Your individual search fees can be reduced retroactively by converting your present agreement to another WESRAC Plan. Phone Marketing Manager, 746-6171.

We are sincerely interested in making our service as valuable as possible to your company. We invite your suggestions and questions regarding any aspect of this program.

Very truly yours,

CALL REPORT

COMPANY: _____ DATE _____

Division Of: _____ PHONE NO.: _____

Address: _____

INTERVIEWED: (Name, Title, Phone Extension)

SUBJECT AND RESULTS:

RECOMMENDATION OR CONCLUSION:

DATE FOR NEXT ACTION:

MATERIAL DISSEMINATED:

Signed _____

WESRAC
SEARCH INFORMATION SHEET

SEARCH
NUMBER

REQUESTING
INDIVIDUAL: _____ DATE OF REQUEST: _____

CLIENT FIRM: _____ CONSULTATION DATE: _____

ADDRESS: _____ DATE RESULTS NEEDED: _____

PHONE: _____

SEARCH TITLE: _____

PROBLEM STATEMENT: (INCLUDE DESIRED AND ACCEPTABLE LIMITATIONS, ETC.)

LIST DESCRIPTIVE TERMS AND SYNONYMS WHICH INDICATE POSSIBLE SEARCH AREAS AND/OR
SUBJECT HEADINGS.

MISC.: _____ PRESENT AT CONSULTATION: _____

WESRAC SPECIALIST: _____ DATE: _____

CLIENT DATA RECORD

NAME _____ CODE # _____

ADDRESS _____ DATE AGREEMENT _____

PHONE _____

PARENT CO. _____

ADDRESS _____

SALES VOL. _____ # LOCAL EMPLOYEES _____

TOTAL ASSETS _____ # R & D EMPLOYEES _____

KEY PERSONNEL (TITLES LOCATION RELATIONSHIP)

PRODUCTS/SERVICES:

PRIME R & D INTERESTS AND CAPABILITY:

COMMENTS: AN. REP. DATE _____ APPLICATION ENGR. _____

CONTACT	PRESENTATION	PROPOSAL	CONCLUSION

DATE _____ REVISED _____

APPENDIX IX

FORMATS FOR REPORTS TO CLIENTS

- A. An example of the Retrosearch Format is included. These reports are bound together with round plastic twenty-two ring binding units.
- B. For Progress Search reports, a binder is provided to the client with spaces for each of the twelve monthly reports. (Not included in the Appendix.)



Wesrac

WESTERN RESEARCH APPLICATION CENTER

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION / UNIVERSITY OF SOUTHERN CALIFORNIA
LOS ANGELES, CALIFORNIA 90007 (213) 746 6133

REPORT
for
Flap Actuators
for
High Temperature Applications
Search 42-171

Prepared for
(Name of Company)
(Date)

prepared by the staff of

WESTERN RESEARCH APPLICATION CENTER

CONTENTS

This report is the result of a computer search, for documents related to your subject, of some 300,000 titles in the WESRAC Data Bank. This is presented to you in the form of abstracts.

ABSTRACTS give a synopsis of documents which your WESRAC specialist considers most relevant to your subject.

The abstracts are divided into two groups. The first group contains those abstracts which are considered to have the most bearing on your problem. The second group contains abstracts which are of possible interest, but not as pertinent as the first group.

A GUIDE to reading the abstracts is in the appendix of this report.

ORDERING PROCEDURE

Upon request, WESRAC will provide complete copies of reports represented by abstracts. To order a particular report, use the Request for Documents form you will find at the back of this report. The numbers refer to the number shown with each abstract. Check the spaces provided to show which documents you need.

Accession Numbers marked with the symbol # are also available on microfiche (4" x 6" sheets of microfilm). These have up to 60 pages on each microfiche. Reading microfiche requires a microfiche reader. If you have access to such a machine and prefer to order a particular item in this form, place an M in the space before the corresponding Accession Number.

Please return the Request for Documents in the envelope provided.

COST AND DELIVERY

WESRAC will provide 100 full-size pages without charge. Full-size pages requested in excess of 100 will be charged to your account at \$.19 per page. To guide you in ordering, the number of pages in each item is indicated on the order form.

Items ordered on microfiche will be charged to your account at \$.75 per microfiche regardless of the number of pages.

Most documents can be provided within three days of receipt of the Request for Documents. However, certain items require from one to four weeks for delivery.

Primary Abstracts

A67-28793

LUBRICATION OF SUPERSONIC AIRCRAFT.

L. C. Lipp (Boeing Co., Seattle, Wash.).

American Society of Lubrication Engineers, Annual Meeting, 22nd, Toronto, Canada, May 1-4, 1967, Preprint 67AM 8A-1, 17 p. Members, \$0.75; nonmembers, \$1.50.

Description of tests made with lubricants to be used on supersonic aircraft. Supersonic aircraft are exposed to temperatures above 450°F and require lubricants adapted to such heat. The test equipment used for their evaluation is capable of testing rolling element bearings at a temperature of 1200°F. This type of evaluation apparatus is simulative of airframe control bearings. For this purpose, a grease must be able to maintain a lubricant film, even though the oscillatory motions tend to push grease away from the loaded areas. Evaporation tests were conducted at 450°F to obtain an indication of the thermal stability of the greases under study. Some lubricants suitable for use at the elevated temperatures to be encountered by supersonic aircraft have been obtained, but there exists a need for further lubrication development. P. v. T.

A67-35966 *

THE SST FLIGHT CONTROL SYSTEM CONCEPT.

James R. Horsnell (Boeing Co., Commercial Airplane Div., SST Branch, SST Flight Controls Group, Seattle, Wash.).

American Institute of Aeronautics and Astronautics, Guidance, Control and Flight Dynamics Conference, Huntsville, Ala., Aug. 14-16, 1967, Paper 67-570, 8 p. Members, \$0.75; nonmembers, \$1.50.

Examination of the electronic and hydraulic systems which will comprise the Boeing SST flight control system. Principal areas of difference between the Boeing SST and current subsonic transports which influence flight-control system design are listed, followed by a brief description of such components of the overall system as the master servos, surface actuators, trim system, malfunction detection system, wing sweep/high lift system, and dual lift-control system. The test programs for all critical components and subsystems are described. R. B. S.

N67-39370* Boeing co., Renton, Wash. Commercial Airplane Div.

A DIRECT LIFT CONTROL FLAP FOR THE 367-80 AIRPLANE

C. R. Taylor and C. C. Flora 19 Sep. 1967 76 p
(Contract NAS2-4200)

(NASA-CR-73147; D6-19580) CSCL 01C

The results of a preliminary design study of a direct lift control flap system for the Boeing 367-80 aircraft are presented. General descriptions of the flap modifications and auxiliary flap actuation and control are given followed by design details of the flap system structural rework, mechanisms, hydraulics, and electrical-electronic system modifications. An autothrottle system design is briefly discussed. Detailed design analyses are included on the proposed modified flap system aerodynamics, airloads and hinge moments, and hydraulic actuation system. R. N. A.

A68-14173

USE OF HYDRAULICS IN THE FLIGHT CONTROLS OF MODERN AIRCRAFT [L'UTILISATION DE L'HYDRAULIQUE DANS LES COMMANDES DE VOL DES AVIONS MODERNES].

M. Cado (Service Technique de l'Aéronautique, Paris, France). IN: THE ROLE OF FLUID MECHANICS IN RECENT TECHNOLOGICAL PROGRESS; SOCIÉTÉ HYDROTECHNIQUE DE FRANCE, NINTH HYDRAULICS CONFERENCE, PARIS, FRANCE, JUNE 1-3, 1966, REPORTS (LE RÔLE DE LA MÉCANIQUE DES FLUIDES DANS LES PROGRES RECENTS DES TECHNIQUES; SOCIÉTÉ HYDROTECHNIQUE DE FRANCE, NEUVIÈMES JOURNÉES DE L'HYDRAULIQUE, PARIS, FRANCE, JUNE 1-3, 1966, RAPPORTS), [A68-14167 03-03]

Paris, Editeur Eyrolles, 1967. 5 p. In French.

General review of the development of assisted control systems in aircraft and of the modern concept of a flight control system. A typical system is described. Attention is given to hydraulic generation, the conditions for use, characteristics, and type of fluid. Hydraulic servo controls are considered, and some auxiliary devices which provide artificial control feel and control damping are described. Comments are made on some future trends. F. R. L.

N68-12654* Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.

HIGH TEMPERATURE HYDRAULIC SYSTEM ACTUATOR SEALS FOR USE IN ADVANCED SUPERSONIC AIRCRAFT Semiannual Report

J. Lee 14 Oct. 1968 87 p refs

(Contract NAS3-7264)

(NASA-CR-91054; FHR-2702-3; SAR-3) CFSTI: \$3.00 CSCL 11A

This report covers the third six-month period of a program to investigate seal materials and to design seals for high temperature hydraulic actuator application. During this work period, assembly and checkout of the second seal test rig has been completed. Work has progressed in the design, fabrication, and test of candidate seal configurations in the one-inch size. Low pressure testing was conducted on the nickel foam metal wedge seal, the Polymer SP V-seal, and the all-metal lip seal fabricated from Vascojet 1000. The latter design met the leakage requirement of less than one drop per minute during 50 hours of testing at 400°F and for 15.5 hours of testing at 500°F. The V-seal exhibited essentially zero leakage during 50 hours of operation at 400°F and 50 hours at 600°F. However, seal leakage exceeded the one drop per minute requirement after 21.75 hours of testing at 600°F. The nickel foam metal wedge seal developed excessive leakage after 17.5 hours of operation at temperatures of 480 to 400°F. Author

N68-10136* SKF Industries, Inc., King of Prussia, Pa. Research Lab.

EXTREME TEMPERATURE AEROSPACE BEARING LUBRICATION SYSTEMS Final Report

L. A. Peacock and L. B. Sibley 20 Jul. 1967 55 p refs
(Contract NAS3-7912)

(NASA-CR-72322; AL67T072) CSCL 131

Angular contact steel ball bearings were tested at 600°F, 43,000 rpm, and 459 lbs thrust load with a hydrocarbon lubricant using a low oxygen environment. Out of 30 such bearings, one bearing per test failed by spalling fatigue of the races or balls in five tests, and in a sixth test one bearing failed by smearing at lives up to twice the AFBMA-computed L₁₀ life. The estimated L₁₀ life of the bearings counting both spalling and smearing failures is about equal to the AFBMA-computed L₁₀, indicating adequate high temperature design life. However, all bearings showed higher lubrication distress in the ball-race tracks than previously tested steel bearings. To observe vibrations at failure, three tests of six unfailed bearings from the above group were continued, but at higher temperatures and loads. Bearing spalling fatigue failures occurred only after the bearing temperatures increased to levels from 670 to 750°F, and the load increased to 900 lbs. The estimated L₁₀ life for these failures is twice the AFBMA-computed L₁₀, indicating satisfactory performance. Author

Secondary Abstracts

N62-12423 Midwest Research Inst., Kansas City, Mo.
LUBRICATION BEHAVIOR AND CHEMICAL DEGRADATION CHARACTERISTICS OF EXPERIMENTAL HIGH TEMPERATURE FLUIDS AND LUBRICANTS.

[Final Report, Jan. 1961 to Dec. 1961.]

Vernice Hopkins, Andrew D. St. John, and Donnell Wilson. Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1962. 116 p. 7 refs.

(WADD-TR-60-855, Pt. II) (Contract AF 33(616)-6854; Proj. 3044)

MLO 60-294 resisted degradation from high shear stresses at 400°, 500°, 550°, and 600° F and wear of the hydraulic pump was small through 500° F. MLO 59-91 at 400° F permitted rapid wear in the hydraulic pump. MLO 59-692 was not degraded by high shear stresses at 550° and 700° F. QF-258 was not degraded at 550° F but experienced a drop in viscosity and flash point during a 100 hr. shear stability experiment at 700° F. Bulk modulus data are presented for MLO 60-294 and QF-258. Results of lubricant behavior in a rolling-sliding contact are presented, and a partial analysis of roller-cage stability is given. Development of the high pressure viscometer is discussed. Solid film lubrication of spherical bushings and the effects of thermal aging of a film are presented. Extreme pressure lubrication of M-10 tool steel at 400° and 600° F and of 52100 steel at 275° and 400° F with an ester of TMP with various additives is discussed. (Author Abstract)

N62-12525 American Oil Co., Whiting, Ind.
DEVELOPMENT OF GREASE LUBRICANTS FOR HIGH TEMPERATURE BALL AND ROLLER BEARINGS OF ELECTRICAL EQUIPMENT. [Report Covering Sept. 1960-Sept. 1961.]

A. C. Borg, K. R. Bunting, A. M. Dobry, R. G. Garst, J. H. Klauwers, H. M. Sellei, R. S. Barnes, and H. J. Liehe. Wright-Patterson, AFB, Ohio, Directorate of Materials and Processes, Feb. 1962. 68 p.

(Contract AF 33(616)-5797)

(WADD-TR-60-557, Pt. II)

The object of this work is the development of grease systems capable of operating in lightly loaded bearings over the temperature range of -65° F to 900° F. The most promising fluids are the higher phenyl content methyl silicones. Other potentially promising fluids are silphenylenes, polyphenyl ethers, chain-type polyphenyls, and phosphonitric chloride polymers and their complexes. Mass spectrograph studies on polyphenyls reveal that these materials have unusual stability under electron impact. Although the high molecular weight polyphenyls are solids with relatively high melting points, a mixed melting point study shows marked lowering in melting points on melts of mixtures of these materials. Imide-thickened greases, despite their apparent good high temperature characteristics as indicated by dropping points above 700° F, do not give satisfactory results in the high temperature bearing performance tests. This is true in both phenyl ethers and phenyl silicones. (Author Abstract)

A63-17599
FIBROUS COMPOSITE MATERIALS FOR EXTREME ENVIRONMENT SEALS.

L. L. Smith (Armour Research Foundation, Chicago, Ill.)

American Society of Lubrication Engineers, Annual Meeting, 18th, New York, N. Y., May 1961, Paper 64AM-1B-2, 23 p.

Description of the development and evaluation of composite materials suitable for use as static and dynamic seals at temperatures ranging from cryogenic to 1,500°F, and at pressures up to 5,000 psi. The steps followed in making composite seals, such as silver reinforced with stainless-steel fibers, are described. The result is a pore-free, two-phase material with sufficient conformability to seal, and sufficient strength to prevent extrusion under extreme temperature and pressure conditions. Physical properties, such as recovery and stress at deformations up to 10%, are determined for various composites at room temperature and at 1,000°F. The results show that the composites have improved recovery and strength characteristics compared with those of the corresponding pure fillers. The successful seal applications considered, using composite materials, include static seals and dynamic seals for rotating and reciprocating shafts.

N63-10194 Southwest Research Inst., San Antonio, Tex.

RESEARCH ON HIGH-TEMPERATURE BEARINGS [Final] Technical Report [Mar. 10, 1960-Mar. 1962]

R. D. Brown, R. A. Burton, and P. M. Ku. Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Aug. 1962. 80 p. 15 refs. (Contract AF 33(616)-7209)

(ASD-TR-61-705)

A description is presented of the evaluation work performed on oscillating bearings of both plain journal and self-aligning types. The bearing substrate materials included cermets LT-1B and LT-2, and alloys F-48 and René 41. Lubricants receiving extensive evaluation were a clad silver-palladium alloy, molybdenum disulfide used in cavities, and bonded molybdenum disulfide. Results include those from friction and wear evaluations, radial load capacity tests on plain journal bearings, and axial and radial load capacity tests on self-aligning bearings. Author

N63-14763 National Advisory Committee for Aeronautics, Langley Aeronautical Lab., Langley Field, Va.

EFFECT OF HINGE-LINE POSITION ON THE OSCILLATING HINGE MOMENTS AND FLUTTER CHARACTERISTICS OF A FLAP-TYPE CONTROL AT TRANSONIC SPEEDS

Robert F. Thompson and William C. Moseley, Jr., Washington, NACA, June 10, 1957. 54 p. 11 refs.

(NACA RM L57C11) OTS: \$5.60 ph, \$1.82 mf (Declassified)

Free oscillation tests were made to determine the dynamic hinge moment characteristics of a trailing edge flap type control surface with various hinge line positions. The essentially full span control was tested on a 4-percent thick, low aspect ratio wing as a reflection plane configuration in the Langley high speed 7 by 10-foot tunnel. The total control chord was 30 percent of the wing chord, and ratios of balance chord to flap chord rearward of the hinge line of 0.20, 0.35, and 1.00 are reported. Test parameters covered a Mach number range from 0.40 to 1.02, control oscillating amplitudes of about 10° or larger, angles of attack of 0° and 6°, and a range of control reduced frequencies. Static data were also obtained for the three control hinge line positions, and results are compared with existing theories. Results show that oscillating amplitude has a large effect on the control aerodynamic damping derivative, and that the damping is unstable in the test Mach number range above about 0.90 for the hinge positions tested. Damping was generally stable at Mach numbers below 0.90, although it was unstable at subsonic speeds for high oscillation amplitudes of the control hinged at the midchord. When the total damping of the control system (nonaerodynamic plus aerodynamic) was unstable, the control fluttered with only one degree-of-freedom, and at transonic speeds the flutter amplitude was decreased by a rearward movement of the hinge line. Author

N63-17684 Mechanical Technology, Inc., Latham, N.Y.

INVESTIGATION OF COMPLEX BEARING AND/OR LUBRICATION SYSTEMS Third Quarterly Progress Report [Nov. 1, 1962-Feb. 4, 1963]

P. Lewis, S. F. Murray and M. B. Peterson. Feb. 12, 1963. 45 p. (Contract AF 33(657)-8666)

(MTI-24(1-63); MTI-63TR5)

Research was conducted on the development of complex bearings and lubrication systems for flight accessory equipment that will operate at temperatures from -65° F to 1500° F, in high vacuum or normal atmosphere, and while exposed to nuclear radiation. The target specifications are for a self-contained bearing system that will operate at 30,000 rpm. Two types of materials were selected for bearing use: metals for below 100° F and ceramics for above 100° F. It appears that two separate solid lubricants will be required, one for the metal bearing and one for the ceramics bearing. For the low-temperature metal bearing, a carbon-graphite retainer looks like an interesting possibility in conjunction with molybdenum disulfide. But this system lacks protection from oxidation. In the high-temperature bearing, the complex oxides appear to be promising. The major problem in this system is to find a suitable retainer material which will provide any supplementary oxide desired and will still have suitable oxidation resistance. C.L.W.

APPENDIX FOR ABSTRACTS

ABSTRACTS

An example of an abstract is reproduced below.

ACCESSION NUMBER

A68-12522

TITLE ► EFFECTIVE G-FACTOR OF CONDUCTION ELECTRONS IN GROUP II-VI COMPOUNDS.

AUTHOR ► A. N. CHAKRAVARTI (Calcutta, University, University College of Technology, Institute of Radio Physics and Electronics, Calcutta, India).

SOURCE ► Indian Journal of Pure and Applied Physics, Vol. 5, June 1967 p. 238-240, 12 refs.

ABSTRACT ► Delineation of a modified form of the formula of Roth et al. (1959) relating the electron effective masses and g-values to the spin-orbit splitting of the valence band in group II-VI compounds. The relation is derived empirically and is found to be in good agreement with the literature data on group II-VI compounds.

ACCESSION NUMBER

This is a unique identification number assigned to each document that is acquired by AIAA or NASA. The "A" accession number identifies this as AIAA material; an "N" accession number would identify NASA material. The number "68" immediately following the "A" indicates that the article was abstracted and announced in the 1968 International Aerospace Abstracts, or in the case of NASA material, in the 1968 STAR Bulletin.

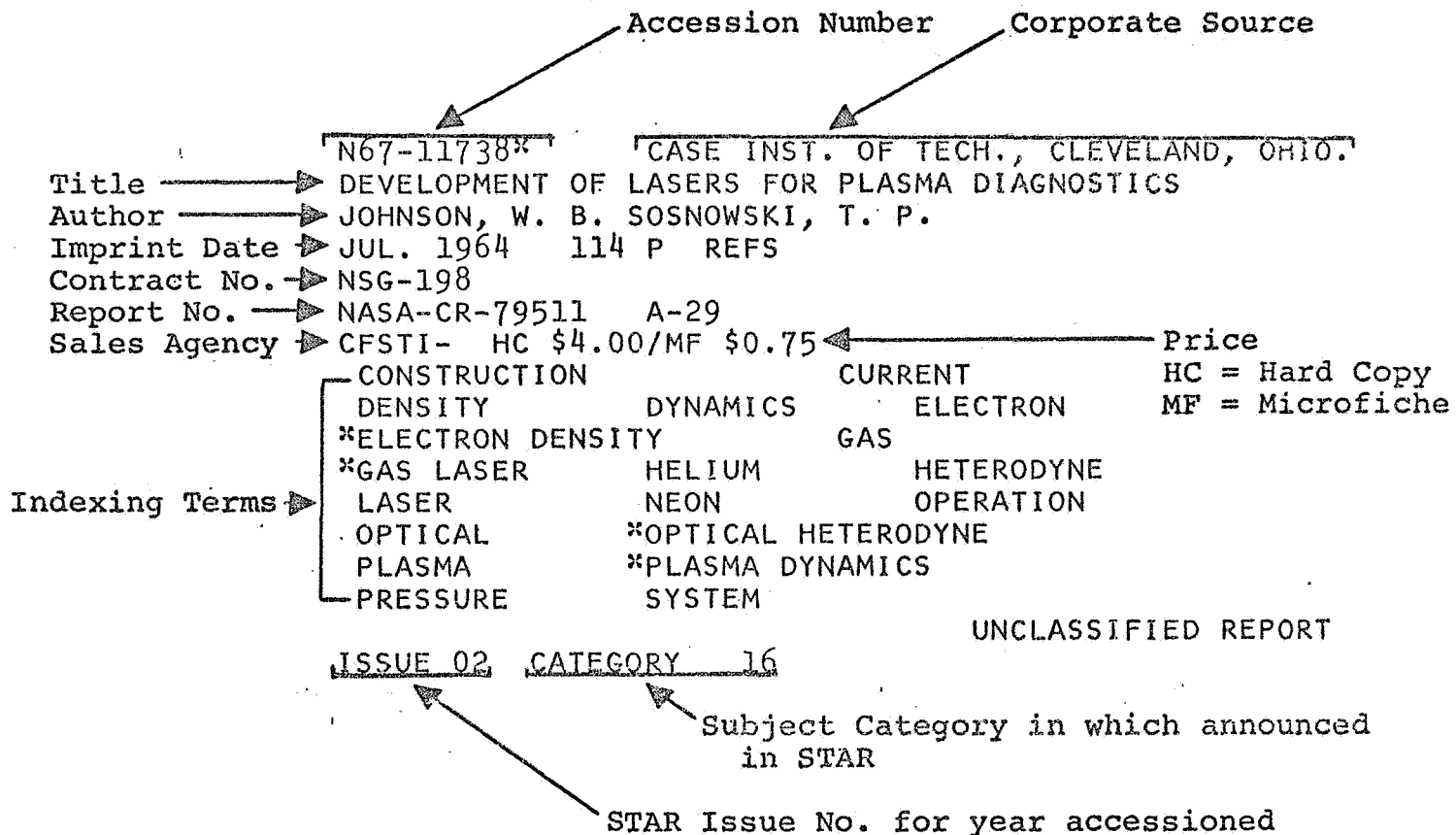
STRATEGY

The following page contains the key words and formula used in your search.

APPENDIX FOR CITATIONS

CITATIONS

An example of a report citation is reproduced below.



ACCESSION NUMBER: This is a unique identification number assigned to each document that is acquired by NASA or AIAA. The "N" accession number identifies this as NASA material. An "A" accession number identifies AIAA material.

The number "67" immediately following the "N" indicates the article as having been abstracted and announced in a 1967 STAR Bulletin, or for AIAA a 1967 International Aerospace abstract. The lines at the very bottom of the citation shows that this report is listed under subject category 16 of issue Number 2 of year 1967.

CONTRACT NUMBER: This is the Number of the NASA Contract which authorizes this research.

CORPORATE SOURCE: This is the firm which did the research reported in this citation.

INDEXING TERMS: These are the keyword terms under which this citation is listed on the magnetic tapes. The asterisks indicate subject headings in the STAR Bulletin under which the citation is listed.

PRICE: This is the price at which you can purchase copies of this report from the sales agency. These prices do not apply for copies acquired through WESRAC. Our prices are listed on the first page of this report.

SALES AGENCY: Copies of this report cited can be bought from this source for the price explained above. They can of course be acquired through WESRAC.

STRATEGY

The page following this one contains the key words and the formula used in your search.

The period (.) means "and," the plus sign (+) means "or," the minus sign (-) means "exclude." Thus if A = Epoxy, B = Bonding, and C = Coating, the statement A.B-C reads "Cite all documents indexed under epoxy and bonding, but excluding all articles that are also indexed under coating."

WESTERN RESEARCH APPLICATION CENTER

SEARCH NUMBER S 1712

(Strategy Used)

AIRCRAFT ACTUATORS
SWARTZ

29 FEB 68

THE FOLLOWING TERMS WERE SEARCHED

LABEL WEIGHT			TITLES SEARCHED
A	10	FLAP CONTROL	00015
B	10	ACTUATOR	00507
C	10	CARTRIDGE ACTUATED DEVICE	00020
D	10	HYDRAULIC ACTUATOR	00052
E	10	SERVOACTUATOR	00062
F	9	FLAP	00560
G	9	WING FLAP	00035
H	1	SUPERSONIC TRANSPORT	01013
I	1	SUPERSONIC COMMERCIAL AIR TRANSPORT /SCAT/	00073
J	1	SUPERSONIC AIRCRAFT	00454
M		SATELLITE	14641
N		SPACECRAFT	11925

THE MINIMUM ACCEPTABLE WEIGHT IS 10

THE MINIMUM LOGICAL REQUIREMENT FOLLOWS

PERIOD (.) MEANS AND

PLUS (+) MEANS OR

MINUS (-) MEANS NOT

$(A+B+C+D+E+(F+G).(H+I+J))-(M+N)$$

WESRAC Search Information Sheet

Client: _____ Date of Request: February 15, 1968
Address: _____ Date Results Needed: Mar. 10, 1968

Phone: _____
Contract No.: 42 Search No.: 171

Client's Representative: _____

Field of Question: Auxiliary Systems

Question: Identify and produce reference literature on flap actuators
for high temperature applications.

Characteristics: (Include desired and acceptable limitations, etc.)

Actuators for flaps on high speed (high temperature)
aircraft such as an SST.

List descriptive terms and synonyms which indicate possible subject
headings and/or search areas:

Aircraft	Heat Resistance
Actuators	Flap
Servomechanism	SST
Temperature	Controls
Hydraulic Systems	

WESRAC's Representative: _____

Meeting Date: February 26, 1968

Misc.: Present:

By: _____ Date: February 27, 1968